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GEOPHYSICS.—*Live aa lava at Kilauea.* T. A. JAGGAR, JR., Hawaiian Volcano Observatory. (Communicated by Arthur L. Day.)

In a paper yet unpublished[1] the writer maintains, from measurement and experiment, that the Kilauea lava column is twofold, a main semisolid incandescent body or "bench magma," filling the Halemaumau pit shaft from side to side for an unknown depth, and a minor shallow liquid lava body or "lake magma," which circulates through several small vertical shafts 10 to 30 metres in diameter. These act as conduits and sinkholes below a saucer 8 to 15 metres deep in the bench magma column, this being the well known "lava lake." The lake magma exhibits a convectional circulation, more rapid than that of the bench magma. It builds the bench magma by overflow and bottom accretion during rising, and uncovers its bottom partially by more rapid subsidence during sinking. The border benches and islands are of crusted protuberant bench magma and are incandescent and mobile within. In the bench magma, under overflooding and its opposite (unloading by the sinking away of the lake), a slow circulation is discernible, which resembles isostatic adjustment in its mechanism.

Under an adjustment of this kind, after subsidence prior to the equinoctial low level of March, 1917, when the lake bottom had been unloaded by a sinking of the lake magma, some 12

[1] Sent to the American Journal of Science.

metres in excess of the sinking of the bench magma (lake bottom), a towering uptilted bench crag on the east side of the interior of Halemaumau subsided 9 metres in the course of twelve hours, and opposite to it in the lake a low flat island rose 12 metres, becoming in one night a towering flat-topped, steep-sided mass. Flow from beneath the crag was compensated by upflow beneath the island, the distortion affecting, not the lava lake, but the lake bottom. At that time the lake near this island was possibly not more than 5 metres deep, proved by subsequent uncovering of the bottom locally. Simultaneously other parts of the bench subsided and island features rose, corroborating by survey the equilibrium relation shown by this extraordinary east island.

Rising began on March 20, 1917, and on March 24 the writer crossed the now solid arch of crust which had formed by congelation and overflow between the east shore of the lake and the island, and examined the base of this monolith. It proved to be aa or block lava. This is the first identification of actual aa under formative conditions in Halemaumau pit known to the writer, though aa exists as rare flows on the floor of the greater crater of Kilauea. It occurs also as graduation forms of the dominant pahoehoe, notably on the west lip of overflow, or rampart of Halemaumau, last actively overflowing when the lava in the pit reached its highest and receded in 1894.

This east island has been figured.[2] The depression of the lake below the rim of the pit at the time of the sudden lift of the island was about 29 metres. The flat elongate islet from which it arose had been 66 metres long on February 14, but only the southern half of this was raised into the new tabular mass, the remainder forming a tumble of pinnacles which extended it northward. The tabular elevation was 25 metres across the top and subcircular. The top was bounded by a vertical cliff 3 metres deep showing horizontal layers of pahoehoe made by lake flooding during fluctuations of the lake level, while the island was low and at or near the lake level. Below was the

[2] Bull. Hawaiian Volc. Obs., Feb., 1917.

aa pedestal sloping outward steeply, scored vertically in places, 9 metres high above lake level, and showing a rough scaly appearance of greenish black color. At lake level its diameter was approximately 45 metres.

The flat islet from which this mass was raised was first noticed February 8, 1917, after 9 metres of subsidence of the lake from its highest level of February 1. The island then appeared as a shoal 60 metres out from the shore in the northern part of the lake, and was supposed to be the product of collapse of a shore point of the eastern bench, which had in turn emerged first as an islet in November, 1916. The locus of the final tabular mass was farther south than either of these.

There is little to be said at this time about the lithology of the aa. It is a heavy block lava which consists of the usual complete, scoriaceous, vesicular units in the talus 5 to 30 cm. in diameter, showing no fracture surfaces, and of reddish or greenish brown color. In the wall the rock is in places grooved vertically like scraped wax, a steel-grey rough substance, and overhanging drip bodies are hard, scoriaceous and quite like the block units. The material is nowhere ropy or membranous like pahoehoe, and has not the slightest resemblance to the crusts and overflows of the lake. It is very similar to the aa flow which was ejected from Mauna Loa in 1916.[3]

STRATIGRAPHY.—*Tongue, a new stratigraphic term, with illustrations from the Mississippi Cretaceous.*[1] LLOYD WILLIAM STEPHENSON, Geological Survey.

The stratigrapher is at times confronted with the problem of adequately treating certain tongue-like extensions of one formation into contemporaneous deposits of different lithologic character and belonging to another formation.

A simple hypothetical case is diagrammatically shown in figure 1.

[3] Amer. Journ. Sci., March, 1917.

[1] Published with the permission of the Director of the United States Geological Survey, and of the Director of the Mississippi State Geological Survey.

Sedimentation began in this assumed area with the deposition of sand, formation *A*; later clay, the base of formation *B*, began to be deposited on the left and as far to the right as *a*, while sand was still accumulating on the extreme right; as time proceeded the sand-forming conditions shifted to the left and upward as far as *b*, followed by a shifting of the clay forming conditions to the right entirely across the area, the latter continuing until all of formation *B* had been produced. The shifting of the two types of sedimentation resulted in the formation

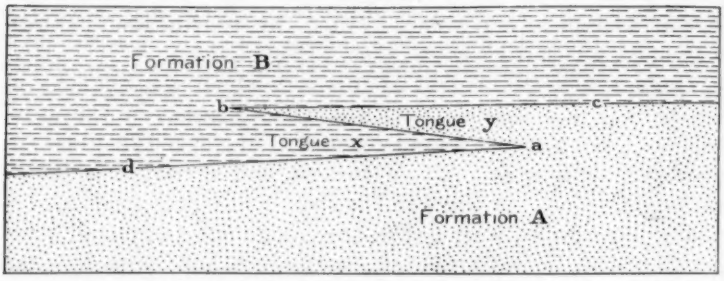

Fig. 1. Diagram showing the relation of tongues to formations.

of a body of clay *x* projecting into the sand formation *A*, and a corresponding body of sand *y* projecting into the clay formation *B*.

So long as such features are relatively small, that is, less than 4 or 5 feet thick and less than a mile long, they can, as a rule, be disregarded in geologic mapping without seriously distorting the facts. There is also no difficulty in their treatment when the area to be mapped does not include the places of junction of the projections with the main formations, for then the features can be classed as lentils, members, or even formations, without apparent inconsistency. But when the projections attain 25 to 200 feet or more in thickness and from a few to many miles in length, and the areas under consideration are large enough to show the connection of the projections with the main formations, the usual methods of mapping compel an arbitrary or even false representation of the facts.

In the hypothetical case represented by figure 1, the boundary between formations *A* and *B* would have to be represented on a geological map in part by drawing an arbitrary line from the outcrop of the point *a* to some such point as *c* on the outcrop of the contact between the main bodies of sand and clay, treating *y* as a sand member or lentil in formation *B*; or by drawing an arbitrary line from *b* to *d* and treating *x* as a clay member or lentil in formation *A*. In either case the true relations would be inadequately represented.

It is therefore proposed that such features as *x* and *y* in figure 1 be designated "tongues" and that for convenience of treatment they be given geographic names correlative in rank in geologic nomenclature with such terms as "member" and "lentil." In geologic mapping it is proposed to extend the color or pattern representing the main formation to include the area of outcrop of the tongue.

Especial emphasis should be laid on the fact that a tongue is not a member nor a lentil, either one of which differs lithologically from the typical material composing the formation of which it forms a part, but is lithologically identical with, or closely similar to, the formation. The term carries with it the implication of connection at one end with the main formation, though the tongue is underlain and overlain by materials lithologically different, and belonging to another or other formations. Theoretically the tongue may end distally in a point; more often perhaps the terminus presents a series of minor tongues; or the material composing the tongue may merge more or less gradually into the kind of material composing the formation into which the tongue projects.

In the present stage of development of the subject it is not possible to set definite dimensional limits to serve as a guide in determining the features to which the term tongue shall be applied. Large-scale maps admit of representing relatively small tongues, that is tongues only a few miles long and a few feet thick. On the other hand a tongue-like projection as large or even larger than some of the units to which the terms member and formation are now applied, may be appropriately called a tongue,

provided the main formation of which it forms a part is relatively much larger. It would seem desirable, however, that the term should be restricted to projections less than half as thick as the main formation, for any mass that is of greater thickness could reasonably be regarded as the continuation of the formation itself, and as such would require no additional name. In the particular examples in Mississippi, to be described on subsequent pages, each of the two tongues, the Mooreville tongue of the Selma chalk and the Tupelo tongue of the Coffee sand member (see pp. 247–8), are about 20 miles long, one is approximately 200 feet thick and the other 100 feet thick. The Oktibbeha tongue of the Selma chalk (p. 249) is between 50 and 60 miles long and only 25 to 50 feet thick; this seems like a rather extreme length for a subordinate geologic feature, but when this tongue is compared with the main formation, the Selma chalk, which is at least 350 miles long, and where most fully developed nearly a thousand feet thick, the tongue is a relatively small feature.

The distance to which a tongue maintains its distinguishing lithologic character down the dip away from the area of outcrop need scarcely be considered in determining what features shall be classed as tongues, any more than the same dimension is considered with reference to lentils, members, or formations; for although changes in conditions of sedimentation oceanward from a shoreline are always interesting in connection with problems relating to geologic processes and geologic history, such factors need not as a rule be taken into account in areal mapping and geologic nomenclature.

The method here proposed for treating tongue-like projections of formations has already met the approval of the geologists with whom the writer has consulted, for those who have had extensive experience in geologic mapping recognize that such features exist, and appreciate the difficulties attendant upon their treatment according to the usual methods of presentation.

It seems desirable to present several concrete examples of the features under consideration to serve in a sense as types for

reference. Four tongues have been differentiated by the writer in the Cretaceous deposits of the eastern Gulf region, three in Mississippi, and one in Alabama, each large enough for representation even on a one to one million scale map. The three tongues in Mississippi and the major formations and members with which they are closely interrelated are shown in figure 2.

As the mention of these examples is in effect the introduction of new geologic names, brief definitions are added. More comprehensive definitions and descriptions will appear in a forthcoming report on the stratigraphy of the Cretaceous deposits of Mississippi.

Mooreville tongue of Selma chalk. The basal part of the Selma chalk of east-central Mississippi is represented in northern Mississippi by contemporaneous non-chalky strata, chiefly sands with subordinate amounts of clay, belonging to the Coffee sand member of the Eutaw. The passage from chalk to sand takes place in western Itawamba and eastern Lee Counties, and is accomplished by the intertongueing of chalk and sand, and by the merging of the one kind of deposit into the other. Two conspicuous tongues are developed, one of impure chalk, here named the Mooreville tongue, which projects from the basal part of the chalk northward into the Eutaw type of deposits, and another of sand, the Tupelo tongue, which extends southward from the Coffee sand member of the Eutaw formation into the chalk, the Mooreville tongue below interlocking with the Tupelo tongue above. These relations are diagrammatically shown in figure 2.

The material composing the Mooreville tongue consists chiefly of argillaceous chalk and shaly chalky clay or marl. An exposure along the Fulton road, ¾ mile west of Mooreville, Lee County, may be regarded as typical. Here the top of the hill is capped with about 8 feet of red weathered sand of the Tupelo tongue of the Coffee sand, beneath which in the road cut is about 20 feet of dark shaly clay from which most of the lime has been dissolved and removed by percolating waters, followed in a deep gully south of the road by about 20 feet of greenish-gray shaly chalky clay, containing small crystals of gypsum in the joint

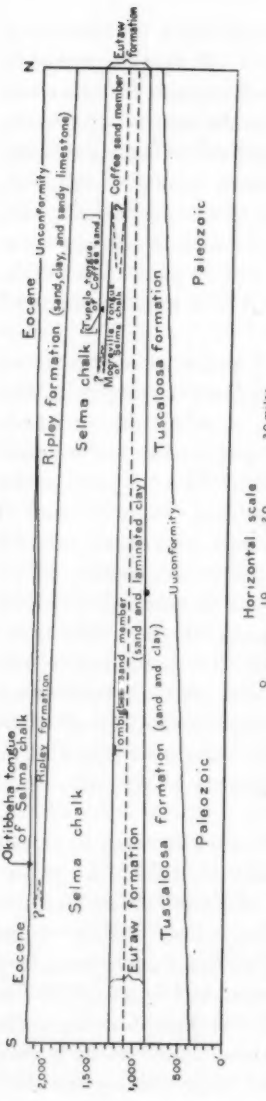

Fig. 2. Diagrammatic vertical longitudinal (parallel to strike) north-south section showing the relation of features described as "tongues" to major formations in Mississippi.

cracks. The thickness of the Mooreville tongue as shown by the log of a well near Tupelo is 215 feet.

The Mooreville tongue finds its physiographic expression in a subdued topography which is in contrast to the hilly aspect of both the area to the west underlain by the Tupelo tongue of the Coffee sand, and the area to the east underlain by the main body of the Eutaw formation.

Tupelo tongue of Coffee sand member The Tupelo tongue of the Coffee sand member of the Eutaw is a body of dark gray, chiefly massive, calcareous, glauconitic sand extending southward from the Coffee sand of northern Lee County into the main body of the Selma chalk, being underlain by a corresponding tongue of chalk, the Mooreville tongue, which extends northward from the basal part of the Selma. The Mooreville tongue loses its identity by merging into—or minor intertonguing with—the Coffee sand type of deposit, in central and northern Lee County, while the Tupelo tongue loses its identity by merging into—or minor intertonguing with—the chalk in southern

Lee County. These relations are graphically shown in figure 2. An exposure in an abandoned portion of the Fulton road, 1½ miles east of Tupelo, is considered the type section (Table 1), though the town of Tupelo is itself underlain by the sand beneath a relatively thin covering of Pleistocene terrace deposits.

TABLE 1

SECTION IN AN ABANDONED PORTION OF THE FULTON ROAD, 1½ MILES EAST OF TUPELO

	Feet
Eutaw formation (Tupelo tongue of Coffee sand member)	
Weathered massive reddish ferruginous marine sand, grading downward into yellowish-green massive slightly glauconitic sand	30
Massive gray, more or less calcerous, glauconitic sand, with several widely separated ledges of calcerous sandstone. *Gryphaea vesicularis* (Lamarck) var., abundant in a layer 15 to 25 feet below the top, and *Exogyra ponderosa* Roemer and *Gryphaea vesicularis* (Lamarck) var., fairly abundant in a layer 10 feet below the top	50

The thickness of the Tupelo tongue as shown by the logs of wells at and near Tupelo is 100 feet.

The Tupelo tongue is physiographically expressed by the hills in its area of outcrop, which contrast with the subdued topography of both the area to the west underlain by the Selma chalk, and the area to the east underlain by the Mooreville tongue of the Selma.

Oktibbeha tongue of Selma chalk. A long thin tongue of chalk projects from the extreme top of the Selma chalk in northwestern Noxubee County, northward through the counties of Oktibbeha, Clay, and Chickasaw, conformably above the southward extending nonchalky sands and clays of the Ripley formation (see fig. 2). This chalk forms the uppermost part of the Upper Cretaceous and is unconformably overlain by strata of Midway age (Eocene). The chalk is typically exposed in gul-

lies on the campus of the Agricultural and Mechanical College near Starkville; on the Mayhew road, $1\frac{3}{4}$ miles east of Starkville; and along the Osborn road within 3 miles northeast of Starkville, Oktibbeha County. The exact thickness of the tongue has not been determined but probably nowhere exceeds 50 feet. In Table 2 is a description of the section exposed in the Mayhew road.

TABLE 2

SECTION IN MAYHEW ROAD, $1\frac{3}{4}$ MILES EAST OF STARKVILLE

	Feet
Selma chalk (Oktibbeha tongue):	
Moderately sandy and argillaceous, chalky limestone with many fossils	26
Ripley formation:	
Gray, finely micaceous, somewhat calcareous sand, with a few slightly indurated ledges	20
Moderately sandy, very calcerous clay	4

Prairie Bluff tongue of Selma chalk. A tongue of chalk in Alabama, similar to and contemporaneous with the Oktibbeha tongue of Mississippi, extends eastward from the main body of the Selma chalk in Marengo County nearly through Wilcox County, south of and parallel to the westward extending extremity of the Ripley formation of Alabama. This tongue appears to be separated from the underlying Ripley sand by an unconformity, probably representing only a relatively short time interval. The term Prairie Bluff is applied to this tongue, being a revival of a name first used in a geologic sense by Winchell[2] in 1857, for the chalk or "limestone" exposed in Prairie Bluff, Wilcox County, Alabama.

[2] WINCHELL, A. Proc. Amer. Assoc. Adv. Sci., 10^2: 84, 90. 1857.

BOTANY.—*Taxonomic botany and the Washington botanist.*[1]

A. S. HITCHCOCK, Bureau of Plant Industry.

Of the 162 members of this society practically all are professional botanists or are professionally interested in some phase of botany. Furthermore most of the members are in the Government service. We are all aware that scientists in the employ of the Government are engaged upon special problems. They become specialists and all their official time is spent upon investigations directly connected with their specialty. Some members, particularly the older ones, have entered the service from professorships, but a large number have become members of this society soon after being graduated from College. The botanist who teaches is compelled by circumstances to keep in touch with the advance along all lines of botanical research. The same is true of many botanists connected with experiment stations, and may be true of a few botanists unconnected with the two classes of institutions mentioned. But how many members of this society are so situated that in the discharge of their official duties they are brought in contact with all the chief lines of botanical science? The number is indeed small. A teacher may specialize, but a specialist rarely retains his grasp upon general botany. Some of us were teachers before entering the Government service, but I venture to say that few of us have retained the impetus acquired from previous training in general botany. The condition then is this: We are a society of specialists and a large proportion of us are young men who from choice or necessity have entered upon a specialty soon after leaving college, often before we have had the time to lay a foundation in general botany broader than that given by comparatively elementary courses.

It is not my purpose to discuss the merits of general versus special training. We must accept conditions as they are and better them if we can. I am sure that all of us welcome opportunities for familiarizing ourselves with the work which is being

[1] Address of the retiring president of the Botanical Society of Washington, delivered March 4, 1917.

done in branches of botany other than our specialties. We read botanical journals; we attend the meetings of this society and of the national botanical societies; we exchange ideas with our botanical neighbors and visitors. In these ways we absorb fragments of botanical information and in a desultory manner keep in touch with the progress of botanical research. There is another opportunity for broadening our outlook, one which yields enjoyment as well as botanical profit, namely, the study of systematic botany.

Therefore to-night I wish to present for your consideration a few remarks on the advantages of taxonomic botany as an avocation. I shall address these remarks particularly to the younger men, though I hope the older members may be cajoled into giving an attentive and sympathetic ear. I hope to show, first, that there is a favorable opportunity here in Washington for the study of systematic or taxonomic botany and, second, that such a study may be a distinct advantage to those who will take the time for its pursuit.

Few of you who are not engaged officially in systematic work are likely to have the time or the inclination to undertake an elaborate monograph of a difficult group of plants. We may therefore dismiss this phase of the subject from consideration. The field of study to which I wish particularly to call your attention is that of the local flora. Here is an opportunity right at our door, fully available during the growing season, partly available even in winter. The student may grasp much or little, as circumstances permit. Recently the study of the local flora has received an impetus through the efforts of several of you who have undertaken to study particular groups and have devised keys to the genera and species of the flowering plants found in the vicinity of Washington. The standard manuals of the flora of the northeastern states include this region. The flora itself has been studied in a more or less desultory manner by several botanists through several decades. The student therefore will find the way fairly well cleared for him. It will be comparatively easy for him to become familiar with the flora, at least in a general way. Except in complex

groups he will be able to coordinate the plants with their botanical names. The pioneer work has been done, but many details remain to be elaborated.

So much for the opportunity; now for the benefits. The advantages may be divided conveniently into two classes, humanitarian and technical. I need say little concerning the humanitarian side of the subject. Those for whom a walk in the woods is a pleasure will accept with little argument the statement that the pleasure is greatly enhanced by a "speaking acquaintance" with the plants they see. They meet plants as friends, they call them by name, they glory in their beauty, they sympathize with their misfortunes and accidents. The stranger in the plant community is greeted with joy and its presence is chronicled in the annals of the excursion as an event of importance. A knowledge of plants turns a Sunday afternoon's aimless meandering into a purposeful quest through Nature's laboratory, resulting in a broadened outlook, a keener enjoyment, and incidentally an increased knowledge of plants.

Let us now turn to the other side, the technical training afforded by studies in systematic botany. All will readily admit the desirability of being familiar with the more important families of plants. A knowledge of family characters brings a concomitant familiarity with the important genera and species. It is a distinct advantage to a botanist, be he physiologist, anatomist, or mycologist, to know the botanical relationships of the economic plants with which he comes in contact and to recognize the family to which belong the common weeds, wild flowers, and cultivated ornamentals. To see a systematist who does not understand the meaning of a Mendelian ratio or the significance of 15 chromosomes, is disconcerting; to see a physiologist who can not distinguish an oak from a maple, or knows not the family relation of cotton and hollyhock, is appalling.

A study of the local flora will afford opportunities for the self-training we are now about to consider. One should go further than merely to find the accepted names of plants. He should do constructive work; he should carry on critical investigations. For this there is abundant opportunity. Every

complex genus in our flora needs further elaboration. Among such may be mentioned Aster, Carex, Cyperus, Meibomia, Panicum, Quercus, Rosa, Rubus, and Viola. There are many others. In fact there is scarcely a genus of the flora that is satisfactorily known; scarcely a genus but which on critical investigation presents surprises. Species have been misunderstood; strange species from the outside are found in our midst; even distinct undescribed species are not rarely brought to view. The genus Panicum has received much attention for many years, but every fresh investigation brings new and interesting facts to light. Botanists may turn to good account intermittent field trips by the accumulation of data however isolated or disconnected. There is a high probability that interesting facts concerning almost any of our species await discovery. These facts may have an important taxonomic bearing. Few of us can recognize in fruit all the species that we know in flower. More should be brought to light about the winter condition of our herbaceous perennials. What are their underground parts and how do they propagate? How many of our annuals are winter annuals and what is their winter phase? A study of the trees, shrubs, and woody vines in winter is a prolific source of enjoyment and botanical profit. Only recently was it discovered that in Danthonia cleistogamous spikelets are produced at the base of the foliage leaf-sheaths, these cleistogenes being strikingly different from the spikelets on the ordinary inflorescence. Yet species of Danthonia have been under observation a hundred years and one species, *D. spicata*, is very common throughout this region, its curly tufts to be seen on every sterile hill. The chickadees showed us that the spikelets of *Panicum clandestinum* hidden in the sheaths are fertile and hence edible, while those of the exserted panicles are sterile and hence have no attraction for them. A keen observer can scarcely walk for an hour through field or forest without gleaning important information for his fellow workers. The accumulation of unrelated data of this kind not only trains the person making the observations but, when placed upon record, also becomes of service to botanical science. The willing worker will find

abundant material close at hand to which he may devote his spare time and from which he may derive the training he seeks. Science will be the gainer by the facts discovered and arranged; the worker will be the gainer by the training and experience.

How the training and experience may be most advantageously obtained will now be examined in detail. Let us suppose that one of us has become interested in the genus Aster as represented in our flora. Here is an opportunity for a genuine taxonomic elaboration of a difficult group, but limited in such a way that all the material may be studied in a fresh as well as in a preserved condition. Collections of herbarium material will of course be secured, because a direct comparison of species is thus made possible. But the worker has the distinct advantage of being able at intervals to consult the living plants and thus to test the conclusions drawn from the herbarium. First he must become familiar with the plants he wishes to study. He will attempt to identify the species by one or more of the standard manuals. Some of the species will fall in place easily; others will be referred with doubt. At first he will be inclined to assume that the author he is following knows all about the genus Aster and has all our species properly placed under the names given in the manual. He may even attempt to distort a description in order that it may fit a given plant. All of us who have used manuals have passed through this stage. But to do really constructive work an investigator must free himself from the shackles of tradition, from the repressing weight of authority. So long as the student accepts without question statements in manuals, or elsewhere for that matter, which do not appear to accord with the facts as he sees them, so long will he be impeded in his efforts, so long will he fail to reach that freedom of mind necessary for unbiased investigation. Nothing has so hampered progress as the inertia of authority. This does not mean that we should not utilize to the fullest extent the results of the work of others. It does mean that we should meet problems with an unprejudiced judgment, unbiased by tradition, unhampered by authority.

Returning to our investigator of asters, his constructive work begins when he has familiarized himself with the work of others, knows the species or groups of species in a general way, and begins to look at things as they are rather than at things as others say they are. In breaking away from tradition he should be careful to maintain an attitude of fairness toward those leaders of thought who have been responsible for the dominance of the concepts he rejects. We all make mistakes and our reputation is affected by their number and character. But to assume that the statements in a manual are free from error in details, and, on the discovery of small errors, to condemn the author and reject his authority, is unfair. If a botanist in whom we have confidence makes a statement concerning Aster which we know to be based upon carefully weighed evidence, we are fully justified in assuming the probable truth of the statement. Nevertheless our worker should not hesitate to verify the statement if it concerns that upon which he wishes to form an independent judgment. While authority may through error turn the channels of thought for a time in the wrong direction, yet the more common hampering effect of authority is an unconscious influence of the leader upon the follower. That is, the follower gives to the casual or ill-considered statements of the leader, the same weight that he does to those carefully thought out. Few leaders fully realize with what unquestioning faith their every statement is received by their loyal followers. Certain statements botanical authorities can make with confidence. Other statements they make casually or with reservations, not always being careful to distinguish by the form of the statement the two mental attitudes.

Having burst the shackles of authority, our friend should make rapid progress with his asters. The exhilarating freedom is delightful but not infrequently seductive. He has now become a specialist. He feels, and with good reason, that he knows more about the District asters than anyone else. He should, however, keep clearly in mind the danger confronting every specialist—the danger of substituting the authority of self for the authority of his predecessors. The tendency to

make definite decisions as to the relations of facts discovered is a natural one but may constitute a real menace in the future. Having made a public statement as to the validity of a species he may be reluctant to make a public retraction, even though the evidence seems to require this. Rather than make a retraction he seeks for facts to support the original statement. He welcomes such facts and magnifies their importance. Facts tending to controvert the statement are excused or brushed aside or given a minimum weight. He may enter that category of scientists who assume the correctness of a theory and subsequently spend their time hunting for facts which will support it. If the investigator can guard against this danger he has accomplished much. If he can look upon his own work and his own published statements with the same detached interest and the same unbiased judgment that he does upon the work of others, he has assumed the truly scientific attitude. One does not like to be accused of drawing hasty conclusions. One does not like to make a statement one day only to deny or modify it the next. Nevertheless if he preserve an open mind toward investigation, the worker will, I believe, find it necessary to change his opinion as the facts accumulate. To accomplish results of the highest value he must establish an hypothesis as a basis for the arrangement of his facts, but this should remain tentative and elastic. The specialist on Aster examines individuals, but the facts thus obtained must be classified and arranged if they are to be of taxonomic use. He soon establishes in his imagination a series of groups which biologists call species. To these groups he attempts to refer all the individuals he meets. It is not advisable to defer the establishment of the specific concepts until the end of his investigations. Theoretically this may be the best procedure, but practically the worker can scarcely avoid forming preliminary ideas of specific limitations. These preliminary concepts should form a temporary hypothesis, to be changed from time to time as the work progresses. The great majority of investigators are able to keep their mental attitude in a responsive condition up to the time they first publish the results of their work. It

is at this point that the danger from crystalization occurs—the danger that the mobile mental attitude will harden. After publication the worker may feel called upon to defend his statements against the attack of critics. What before was a detached investigation of facts becomes an effort at personal vindication. All these troubles might be avoided by deferring publication. Indefinite delay, however, is not advisable. Actually to finish an investigation before results are published would usually mean no publication. The author should be unhampered but should choose the happy mean between "rushing into print" with half-prepared preliminary notes, and indefinitely delaying publication till a perfect monograph may be produced. It is of course desirable to ascertain before publication all the facts bearing upon a subject but sometimes our hands are forced in such matters. Publication on a given subject may call for a statement concerning something which has not been thoroughly investigated. All of which emphasizes two points already mentioned, that equal weight should not be given to all the statements of an author, and that the author himself should correct his own errors as freely as he corrects those of others.

Our worker with Aster will have the opportunity for training in another field, that of taxonomic judgment. It is well that every scientist should have training in the two methods of establishing facts, by experiment and by repeated observations. Most facts in physical science are established by experiment; most facts in descriptive biology are established by repeated observations. In practice a taxonomist is called upon to classify individuals into species, and species into genera. A species is not a law or a fact that can be proved by experiment. It is a taxonomic idea which can be established only by a great repetition of observations. Our classification is based upon the evolutionary hypothesis that all living organisms are descended from other somewhat different organisms of the past. Setting aside the differences of opinion as to the independent origin of the larger groups, it follows that all organisms, at least of family groups, are probably genetically connected. Their lines of

descent are not known to us. We are able to observe, not the complete connecting lines as represented by an infinite number of individuals, but only a cross section of the lines as represented by the organisms of the present. The task of the taxonomist is to form an opinion as to the probable relationships of the individuals. This taxonomic judgment is based upon and is developed by experience. In many cases the evolution has proceeded so far that a group of individuals has become distinctly separated genetically from its allies. The individuals of this group interbreed freely and form a coherent aggregation to which biologists have applied the term species. If all organisms had, through the process of evolution and the elimination of intermediates, become definitely segregated into these distinct coherent groups, the task of the taxonomist would be greatly simplified. The species being definite, he would be obliged only to offer guesses or opinions as to the relations of the species, and to classify them into groups. However, evolution is still going on, new species are forming, and old species are becoming extinct. We see, as it were, a still scene from a series of moving pictures representing the development of organisms. In complex groups such as Aster the lines of descent are still nearly parallel. They are clustered, but only here and there is the divergence sufficient distinctly to separate the clusters. More often the clusters are contiguous and can be only artificially separated where the density of the lines is least.

Thus it is clear that there are two steps in the study of classification. First the facts must be established as to the relative position of these lines of descent. In effect one must plot out in his imagination a cross-section of these genetic lines, the points representing the individuals examined, and the position of the points representing the variation of the individuals from the average of the group in the totality of their morphological characters. The second step is the interpretation of the results in terms of species. In the genus Aster, to which we are constantly returning for an illustrative example, there are certain pencils of lines that stand out distinctly in the plot. There is no difficulty in determining the definiteness of these

groups and there is no hesitation in pronouncing them distinct species. But there will be many cases where the groups are not distinct. There will be a segregation of dots at different points, a greater density of grouping, but the groups will not be definitely separated by blank areas. Lying between are scattered dots representing individuals which cannot be assigned definitely to any of the surrounding groups. The investigator must decide whether these indefinite but denser aggregations of dots represent species or whether the larger group which can be definitely separated from its surroundings shall be called a polymorphous species. Evidently we have to do here with species in the making and we may expect to find stages in the process. The decision as to the limitation of species must in some cases be arbitrary, no matter what standard for comparison be chosen, and may often be dictated by convenience or expediency. The sorely perplexed taxonomist can at least take comfort in the thought that he is not responsible for the vagaries of the plants and that it is not necessary for him to force the plants to conform to a concept. As some great philosopher has said, When in doubt tell the truth. We seek the truth, not the vindication of a theory. As stated above the taxonomic judgment is based chiefly upon experience. The worker determines the amount of variation in groups which the concensus of botanical opinion recognizes as species. One who is investigating asters should at the same time extend his observations to other groups of plants if he has not already accumulated a taxonomic experience. An inability to assign individuals to established species may not mean that the specimens are intermediates nor that the species are invalid. It may mean lack of knowledge on the part of the investigator.

After a worker has completed an investigation he should place the results on record for the benefit of science. The investigation has trained the worker and developed his judgment, but the results are lost to science unless they are published. Publication of results is a training in itself which adds greatly to a young man's efficiency. The points chiefly to be considered in preparing manuscript for publication are clearness, concise-

ness, and care in technique. The proper interpretation of results from observed data requires clear thinking. Clear thinking leads to clear writing. While it is occasionally true that a clear thinker may through carelessness write in an ambiguous or indefinite manner, he lays himself open to the suspicion that his thinking is no clearer than his writing. For the sake of himself and of his associates his results should be given with all the conciseness that is consistent with clearness. The literature upon all subjects is now so extended that no inconsiderable part of a scientist's time is devoted to reading the published results of others. Every man owes it to his associates to reduce to a minimum the time required to read the record of his results. Furthermore, a verbose report is often temporarily set aside with the intention of examining it when there is more time, an intention that is rarely fulfilled. If the report actually requires a wealth of detail there should at least be a succinct summary. We should learn early in our career that the really new and valuable points brought out in an investigation are usually few, and that these few points should be laid before our associates with clearness and precision, and not hidden in verbosity nor diluted by a mass of detail. To be able to compress statements of results into a small compass without loss in value to the scientific world is an evidence of distinction.

I cannot leave this subject without touching upon the question of technique, a question considered by some as trivial or inconsequential. I feel constrained the more to confide in you at this time because I have the misfortune to be a member of two editorial boards. The editors find that some writers will nearly choke to death over a comma, that others think punctuation marks are merely to be distributed over the page for ornamental purposes; that some use words to express their thoughts, that others use the same words but obscure their thoughts; that some are so burdened with technique that their thoughts seem imbedded in paraffin, that others look upon technique as an editor's instrument of torture. But seriously, technique is as important to the writer as to the painter, the sculptor, or

the engineer. And it should be as important to the writer of scientific articles as to the writer of novels, essays, or philosophical papers. A lack of attention to such details as punctuation, capitalization, and consistency in the abbreviation of bibliographic titles, and still more to careful diction, may with some justification be considered as indicating a similar lack of attention to details in carrying on the investigation which the paper records. The author should examine and correct his own paper with the same care and detached interest with which he, as an editor, would go over the manuscript of another. It is an evidence of scientific ability to be able to hold one's self firmly to every detail of his task, drudgery though it be, from the preliminary laying out of the plan of the work to the proper placing of the last comma in the finished manuscript.

At the beginning of his scientific career, every worker has before him an ideal which is a guide and an inspiration, a measure of accomplishment. This guide is usually the published paper of a prominent botanist, one in whom he has confidence and who has fired his zeal. As he advances along his chosen path he shifts his standard of accomplishment, but it should be always above or beyond. No man is perfect; no man's work is perfect. Only an ideal can be perfect. The axiom, the whole is twice the half, is an abstract truth, a perfect ideal. But we are never able to reach this ideal in practice. Our most careful measurements fall a little short of exact mechanical demonstration. The scientific worker progresses so long as his ideal is well in advance, be it the work of a teacher or leader, or be it abstract perfection toward which we all strive but which we never reach. But so soon as his ideal is his own best work, his progress ceases.

I have endeavored to outline to you the advantages to be gained in a study of some branch of taxonomic botany by those members of the society who are officially engaged in investigations along other lines. The local flora offers abundant opportunity for advancing scientific knowledge and for self-training in scientific methods. It cannot be claimed that taxonomic botany affords better opportunity for such training than does

any other branch of science. But we are already botanists; in the main our development will continue in this broad field. What I would point out is that now and again we can leave our desks and microscopes and laboratories for prairie and forest and stream, and that we have a field close at hand in which we can train our powers of observation and our taxonomic judgment, at the same time enhancing our enjoyment and extending the bounds of botanical knowledge.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

PHOTOMETRY.—*An "average eye" for heterochromatic photometry, and a comparison of a flicker and an equality-of-brightness photometer.* E. C. CRITTENDEN and F. K. RICHTMYER. Bureau of Standards Scientific Paper No. 299 (Bull. Bur. Stds., **14:** 87–113). 1917.

The comparison of lights of different colors is supposed to be based on an "average normal eye." This paper records an attempt to approximate the results of such an eye with typical color differences by using a large number of observers. In particular, results obtained by a flicker photometer and by an equality-of-brightness photometer, with different degress of color difference, are compared. In terms of the Ives-Kingsbury test solutions, for which the proposed normal ratio of transmissions (with a 4 wpc. carbon lamp) is 1.00, the average of 114 observers gives a ratio of 0.99. By using these test solutions results obtained on the flicker photometer by a small number of observers can be corrected so as to give normal values with a high degree of accuracy. On the average, equality-of-brightness measurements also vary in proportion to the test ratio, but erratic variations often overshadow these systematic differences. For sources having relatively high intensity in the blue, flicker values tend to fall below those obtained on the usual standard photometers, but the difference is comparable in magnitude with the uncertainty of the latter values.

E. C. C.

GEOLOGY.—*Anticlines in the Blackfeet Indian Reservation, Montana.* EUGENE STEBINGER. U. S. Geological Survey Bulletin 641–J. Pp. 281–305, with 2 plates and one figure. 1917.

This paper gives a brief account of the geologic formations in the Blackfeet Reservation and of their geologic structure, and a more de-

tailed description of the anticlines and of the formations that appear to contain oil or gas in southern Alberta and northern Montana. The general conditions in this region suggest that drilling in the Blackfeet Indian Reservation would have about the same chance of success as in the adjacent region in southern Alberta, extending from the international boundary northward to Calgary, a region in which drilling by over 40 companies during the last three years has been slightly successful. R. W. S.

GEOLOGY.—*Anticlines in central Wyoming.* C. J. HARES. U. S. Geological Survey Bulletin 641–I. Pp. 233–279, with map and 19 figures. 1916.

The area herein designated central Wyoming covers nearly 5000 square miles in Natrona and Fremont counties west of Casper and southeast of Lander, and includes no proved oil fields. This area was investigated primarily to ascertain the possibilities of oil, and as a result it was found that the Carboniferous and Cretaceous formations which produce oil in other Rocky Mountain fields are well developed in central Wyoming and in places the oil seeps from them, but in only a few places are these formations covered by impervious shale and within reach of the drill in folds favorable for the accumulation of oil and gas. The favorable folds are pointed out, but even these most favorable folds may be barren of oil. R. W. S.

GEOLOGY.—*Oil shale in northwestern Colorado and adjacent areas.* DEAN E. WINCHESTER. U. S. Geological Survey Bulletin 641–F. Pp. 139–198, with bibliography, 10 plates and 2 figures. 1916.

This report contains information showing the quantity and quality of oil that may be distilled from the richer beds of shale, the number of such beds at the different localities examined, and the general distribution of the shale throughout northwestern Colorado and adjacent parts of Utah and Wyoming. The results show that the shale of the Green River formation will yield a vast quantity of oil, gas sufficient to carry on the process of distillation, and fertilizer enough to enrich most of the farms of the Middle West, and that this reserve is ready whenever the demand is sufficient to warrant the establishment of a new industry to supplement the failing supply of petroleum from the oil fields. R. W. S.

GEOLOGY.—*Placer deposits of the Manhattan district, Nevada.* HENRY G. FERGUSON. U. S. Geological Survey Bulletin 640–J. Pp. 163–193. 1917.

The Manhattan district is in part a region of intensely contorted Paleozoic sediments and in part covered by Tertiary volcanics. The lodes from which the placer gold is derived occur principally in the Cambrian schist, but are of Tertiary age. Manhattan Gulch, draining the central part of the district, has yielded a large amount of placer gold. The bed-rock gravels from which the bulk of the placer gold has been obtained were laid down in Pleistocene time, and the accumulation of gold is the result of successive concentrations. Of particular interest is the regular increase in purity of the placer gold with the distance from its source. In a distance of two miles down the gulch the fineness of the gold changes from 700 to 740 parts per 1000.

H. G. F.

GEOLOGY.—*Economic geology of Gilpin County and adjacent parts of Clear Creek and Boulder Counties, Colorado.* EDSON S. BASTIN and JAMES M. HILL. U. S. Geological Survey Professional Paper 94. Pp. 379, with 23 plates and 79 figures. 1917.

Gilpin County and the adjacent portions of Boulder and Clear Creek Counties, Colorado, lie nearly west of Denver in the heart of the Front Range of the Rockies. Central City, the seat of Gilpin County, is the oldest lode-mining camp in Colorado and in total production one of the most important.

Most of the rocks of the region are pre-Cambrian in age. Some of them have undergone severe dynamic metamorphism; others are practically unmetamorphosed. The pre-Cambrian rocks are intruded by a great variety of much younger igneous rocks, most of them porphyritic in texture. Though they show some diversity in age, all are believed to have been intruded in Tertiary time. They occur as stocks and dikes, and are abundant in all parts of the region.

The region forms part of a broad mineralized belt which embraces most of the economically important mining camps of Colorado. The ores of the region may be classed, according to the metals which give them their predominant value, as (1) gold-silver ores, which constitute the main economic resource of the region; (2) uranium ores, which occur in a few places only but are of much interest as a source of radium; (3) tungsten ores, which form the basis of the tungsten industry of Boulder County, the most productive center for this metal in the

United States; (4) ores worked primarily for copper; (5) titaniferous iron ores. Most of the ores occur as veins, as a rule steeply dipping, which are in part fissure fillings and in part replacements of various rocks along zones of fracturing. All the ores of the region are believed to be genetically connected with the Tertiary (?) intrusive rocks.

Enrichment in the Central City region has been confined mainly to the class of gold-silver ores. Enrichment in gold appears to be confined almost exclusively to portions of the ore deposits above or immediately below the ground-water level. Silver enrichment is confined to the ground-water zone. Enrichment in copper is nowhere conspicuous. R. W. S.

GEOLOGY.—*Brachyceratops, a ceratopsian dinosaur from the Two Medicine formation of Montana, with notes on associated fossil reptiles.* CHARLES W. GILMORE. U. S. Geological Survey Professional Paper 103. Pp. 44, with 4 plates and 57 figures. 1917.

This paper gives as complete and detailed a description of the skeletal anatomy of *Brachyceratops montanensis* as the material at hand will permit, and discusses briefly in systematic order other forms represented by specimens in the collection made in 1913 on the Blackfeet Indian Reservation.

The stratigraphy of the Two Medicine formation is discussed by Eugene Stebinger. Vertebrate fossils are found throughout the upper part of the Two Medicine formation and nearly all of them belong to the class Reptilia. The great number of trachodonts found appears to indicate that these were the most abundant dinosaurs of the epoch. Next to the Trachodontidae, the Ceratopsidae were most abundant.

Fragments of turtles are plentiful; a few teeth and single bones of extinct crocodiles, and isolated scales and plates of ganoid fishes were found. The vertebrate fauna of the Two Medicine formation, as represented by this small collection, although too meager to serve as a basis for close comparisons with related faunas, accords with the stratigraphic evidence for the correlation of the upper part of the Two Medicine formation with the dinosaur-bearing beds of the Judith River and Belly River formations. R. W. S.

MINERALOGY.—*Notes on alunite, psilomelanite, and titanite.* EDGAR T. WHERRY. Proc. U. S. Nat. Mus., **51**: 81–88. 1916.

Includes descriptions with analyses and discussions of the composition of two specimens of alunite, one of psilomelanite, and one of titanite. E. T. W.

MINERALOGY.—*Glauberite crystal cavities in the Triassic rocks of eastern Pennsylvania.* EDGAR T. WHERRY. American Mineralogist, **1:** 37–43. 1916.

The crystal cavities in the sedimentary rocks, previously mentioned in connection with announcement of the character of lozenge-shaped cavities in zeolite deposits (Journ. Wash. Acad. Sci., **6:** 181–4. 1916) are described in detail. They are shown to agree crystallographically with the mineral glauberite. Pseudomorphs of calcite after glauberite are also described. It is believed that the glauberite formed as the result of evaporation of lake waters of Triassic times. E. T. W.

TECHNOLOGY.—*Glasses for protecting the eyes from injurious radiations.* W. W. COBLENTZ and W. B. EMERSON. Bureau of Standards Technologic Paper No. 93. Pp. 14. 1917.

The object of the present paper is to give the general characteristics of certain newly developed glasses sometimes used for protecting the eye from radiant energy, especially from the infra-red or so called heat rays. Because of the difficulty in reproducing the same color in different melts, no attempt is made to give specific data on the transmission for a given thickness of glass. The data given are representative of an extensive group of glasses available for protecting the eye from (1) the ultra-violet, (2) the visible, and (3) the infra-red rays.

For protecting the eye from ultra-violet light, black, amber, green, greenish-yellow, and red glasses are efficient. Spectacles made of white glass afford some protection from the extreme ultra-violet rays. For shielding the eye from infra-red rays deep black, yellowish-green, sage green, gold plated, and bluish-green glasses are efficient. For working near furnaces of molten iron or glass if considerable light is needed, a light bluish green or sage green glass is efficient in obstructing the infra-red rays. For working molten quartz, operating oxy-acetylene or electric welding apparatus, or other intense sources of light, it is important to wear the darkest glasses one can use whether black, green (including gold plated glasses), or yellowish-green, in order to obstruct not only the infra-red but also the visible and the ultra-violet rays. Of the infra-red rays emitted by a furnace heated to 1000 to 1100°C about 99 per cent are obstructed by gold plated glasses, about 95 per cent by sage green or bluish green glasses, about 80 per cent by very deep black glasses, and about 60 per cent by greenish yellow glasses. W. W. C.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 786th meeting was held March 17, 1917, at the Cosmos Club, President BUCKINGHAM in the chair; 51 persons present. The minutes of the 785th meeting were read in abstract and approved.

Mr. WILLIAM BOWIE read a paper on *Our present knowledge of isostasy*, which was illustrated by a number of slides. After reviewing briefly the conclusions reached by Prof. Hayford, Mr. Bowie discussed the recent researches in gravity and isostasy.

In these investigations the results obtained at 219 stations in the United States, 42 stations in Canada, 73 stations in India, and 40 stations in other countries, were used. Isostasy seems to be about as complete in each of the countries where extensive data were available as in the United States, although it was not possible to make certain tests for the other countries, owing to lack of certain detailed data.

Isostasy in the United States, for the whole area, is practically perfect. For local areas gravity is, on an average, 0.020 dyne from normal. This anomaly corresponds to a mass of material of indefinite horizontal extent and thickness of about 600 feet. Whether this average deviation from normal in gravity is caused by a lack of isostatic compensation or whether it is caused by the presence of extra light or extra heavy material in the outer portion of the earth's crust close to the station is a problem that cannot be entirely solved by the use of present data.

It was found, during the investigations of the Coast and Geodetic Survey, that the gravity anomaly showed some relation to the geological formation on which a station is located. For instance, on the pre-Cambrian formation, where the rocks are denser than normal, gravity is in excess at nearly all stations. For the stations on the Cenozoic formation, the density of the material of which is somewhat less than normal the anomaly tends to be negative and all of the larger anomalies of those stations are negative. There was not found any relation between the gravity anomaly and the densities of the materials of the Mesozoic and Paleozoic formations.

Various tests were made for determining the most probable depth of compensation. The result was a depth of 95 kilometers, but the speaker emphasized the fact that this depth may be very indefinite

and may not exist as a definite surface. It is only in case of a uniform distribution of the compensation that there could be a definite surface limiting the distribution of compensation. It was stated that the uniform distribution was adopted in the computations to facilitate the progress of the work. Any one of several distributions, other than that of uniform distribution, would give practically the same results. This is somewhat of a surmise, as no elaborate tests were made.

The application of the theory of isostasy to the gravity data made it possible to derive a formula for giving gravity at sea level at any latitude. 348 stations in the United States and other countries were used in the derivation of a number of formulas on various assumptions. One of them, the best formula probably in the world, is $\gamma = 978.039 (1 + 0.005294 \sin^2 \phi - 0.000007 \sin^2 .2\phi)$ in which γ is the value of gravity sought and ϕ is the latitude of the station.

Discussion. Mr. G. K. BURGESS asked about the possibility of using the Eötvös torsion balance for determining variations in the intensity of gravity, and about the complete absence of magnetic materials in the pendulum used.

Mr. BAUER questioned whether the depth of compensation did not vary with the topography, and Mr. Bowie called attention to the fact that the data from stations located on plains did not permit of a solution for the depth.

Mr. W. F. G. SWANN then gave a paper on *The origin of the earth's electric charge.* Measurements of the variation of the penetrating radiation with altitude point to the upper atmosphere as the origin of a part of this radiation. The whole of the penetrating radiation is probably of the γ ray type, but the part which reaches the Earth's surface from the outer atmosphere is naturally the most penetrating part. Indeed, it is so penetrating that it passes through a thickness of air which would be equivalent, in absorptive action, to a column of mercury 76 cm. high, if absorption coefficients were simply proportonal to density and were independent of material. The γ ray radiation from the outer layers of the atmosphere will consequently be very "hard," and, in accordance with the known results of laboratory experiments, we must conclude that the negative corpuscles which it emits from the air molecules are emitted almost entirely in the direction of the radiation, and further, that they can have a range in air at least equal to that of the swiftest β rays from radium products. The emission of corpuscles by these γ rays will consequently result, at each point of the atmosphere, in a downward current of negative electricity, which we shall call the corpuscular current. This corpuscular current will charge the Earth until the return conduction current balances the corpuscular current at each point of the atmosphere.

Taking, for the purpose of this abstract, a simplified case where the penetrating radiation considered is all directed vertically downwards, if q is the number of corpuscles liberated per cubic centimeter per second by the penetrating radiation, and h is the average distance

which a corpuscle travels from its point of origin, the corpuscular current density will be

$$i = qeh$$

where e is the electric charge.

If account be taken of the fact that the radiation passing through 1 sq. cm. comes from all directions lying within a hemisphere, the result is to introduce a factor of $\frac{1}{2}$, so that

$$i = \tfrac{1}{2}\, qeh$$

The average value of the air-earth current density as obtained from several stations is 6.7×10^{-7} E.S.U., so that if q be taken as 3, which is about equal to the number of pairs of ions produced per cubic centimeter per second in a closed vessel, as a result of the part of the penetrating radiation in question, the value of h necessary to account for the measured current-density is 9 meters. This value is quite within the range of posibility, since Eve has observed β rays at a distance of 7 meters from the source.

A few minor difficulties present themselves. Thus, for example, near the surface of the Earth a considerable portion of the whole penetrating radiation comes from the soil, and is directed upwards, but this difficulty disappears when it is remembered that the average "hardness" of this radiation is very much less than that of the radiation which reaches the Earth from the outer layers of the atmosphere. Again, it might appear that the corpuscles set free by the penetrating radiation should, on account of their great energy, produce in the atmosphere many more ions per second than are actually found to be produced. This difficulty and others of allied nature become greatly reduced in magnitude, however, when considered in the light of our present knowledge of the action of very swift β rays when passing through a gas.

Discussion. Mr. BAUER spoke of the possibility of some of the penetrating radiation being of solar origin.

DONALD H. SWEET, *Secretary.*

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 568th regular meeting of the Society was held in the Assembly Hall of the Cosmos Club, Saturday, March 24, 1917; called to order at 8 p.m. by President HAY; 31 persons in attendance.

Under the heading of book notices Dr. L. O. HOWARD said he had carefully examined the work on beetles presented to him at the 567th meeting of the society by Dr. H. M. Smith, and found that it was a hand made copy of all the descriptions of the North American beetles contained in a large French monograph dealing with that group of insects.

The regular program consisted of three communications:

W. P. TAYLOR: *Notes on Aplodontia.* Dr. Taylor said the peculiar west American rodent *Aplodontia,* discovered by Lewis and Clark, is the sole living representative of the family Aplodontiidae. It is exclusively North American in origin, development, and distribution. Found in Tertiary times in the Great Basin region and even as far east as South Dakota, the family is now limited to the Pacific Slope of North America. *Aplodontia* is colonial and fossorial, feeding exclusively on the vegetation in the vicinity of its burrows. The aplodontid phylum is noteworthy for its extreme conservation. During a lapse of time which sufficed to transform the horse from the Miocene *Merychippus* type to the larger Pliocene *Pliohippus,* there appears to have been no appreciable change in the tertiary species *Aplodontia alexandrae*; and during the time when the *Merychippus* type of horse became transformed into the modern *Equus* with modifications in every bone in the body and characters generically probably twice removed, the aplodontid stock has undergone comparatively little change, all observed variations, as at present recognized, falling within the limits of a single genus.

Dr. Taylor's communication was discussed by Messrs. T. E. WILCOX, N. DEARBORN, A. WETMORE, L. O. HOWARD, N. HOLLISTER, and R. W. SHUFELDT.

W. DWIGHT PIERCE: *The extaordinary strepsipterous type of parasitism.* Mr. Pierce spoke of the extraordinary type of parasitism displayed by the insect order Strepsiptera. He called attention to the great diversity in form between the male and female *Strepsiptera.* All species of this order are parasites in the bodies of bees, ants, wasps, leafhoppers, and grasshoppers. The only part of the body which can be seen when in the host is the cephalothorax which protrudes between the segments of the host abdomen. The females are legless and blind, and have no appendages except mandibles, which are of no value after the cephalothorax has been protruded from the body. They give birth to living young which emerge from the body of the parent through a canal between her unshed larval skin, and the true adult, reaching the body of the host through an opening between the head and thorax of the parent. These young, in order to find their next host, must be deposited on some flower visited by the species which they parasitize. They are then carried by the nest-building hosts to their nests and there find larvae to attack. Shortly after entering the new hosts they lose their legs and become very degenerate in appearance. The males have one pair of wings, the front pair being reduced to tiny balancers. They are very active creatures with slender legs, immense stalked eyes which look like raspberries, and degenerate mouth parts. These insects are world wide in their distribution, but very rare. Mr. Pierce's communication was discussed by Messrs. L. O. HOWARD, E. A. GOLDMAN, and W. P. HAY.

R. W. SHUFELDT: *Zoological statuary at the National Capital.* Dr. Shufeldt, after relating his experiences with the sculptor, John Rogers, in 1872, and with others in the studios of New York City forty years

R. W. SHUFELDT: *Zoological statuary at the National Capital.* Dr, Shufeldt, after relating his experiences with the sculptor, John Rodgers. in 1872, and with others in the studios of New York City forty years thereafter, pointed out how generally it was the case everywhere that sculptors ignored the teachings of biologists, carrying their idealism to such an extreme that many of the elaborate pieces, intended as ornaments in places of prominence in cities, were untrue to nature, highly rediculous in conception, as well as in execution. This rule applied to a large part of the sculptural pieces in the City of Washington, and to this there were but too few exceptions. Among these latter were the tigers and buffaloes of Mr. Proctor. Through the use of his lantern slides Dr. Shufeldt illustrated his remarks and criticisms of a considerables number of the pieces of animal sculpture about the city. Exception was taken to the employment of nonindigenous animals as American models for such purposes, and especial objection was made to the lion, which, the speaker said, should be supplanted bp our own native forms, as the elk, moose, cougar, and other types.

Dr. Shufeldt's communication was discussed by Messrs. L. O. HOWARD, H. E. AMES, W. P. HAY, J. W. GIDLEY, G. W. BAIRD, and others.

M. W. LYON, JR., *Recording Secretary.*

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 509th meeting of the Society was held in the Lecture Hall of the Public Library on March 19, 1917. On this occasion Dr. FAY-COOPER COLE, of the Field Museum of Natural History, Chicago, delivered a lecture before the society on *The pagan tribes of the Philippines.*

He first took up the peopling of the Islands and the intermingling of peoples which has resulted in the present population. The pigmy blacks or Negritos were held to be the aboriginal inhabitants of the islands. They were driven back from the coasts, and finally to a few isolated regions by the pressure of invaders, most of whom came in from the south. Many of the pigmies were enslaved or otherwise merged with newcomers and, as a result, traces of this intermixture are now to be seen in every tribe of the Philippines.

The invading peoples are believed to have come in several waves, not as a part of a great single movement. The earliest of these waves appears to have been made up of a people who were physically closely lalied to the Polynesians. They were followed by successive invasions of primitive Malays—a people with closer affinities to the Mongoloid people of Southern Indo-China and the earlier inhabitants of Burma. These early inhabitants appear to have intermarried to a great extent, and later to have mixed with newcomers so that today the population is of a very complex nature. Dr. Cole showed a number of slides of members of the Bukidnon tribe of Central Mindanao. In this group three types continually appear—oftentimes in the same family. The first type has distinct negroid features showing the admixture of Negrito blood; the second closely approximates the Christianized Visayan of the Coast; while the third element is made up of people who in all but color closely resemble Caucasians.

The effect of movements of alien peoples and beliefs into Malaysia, in historic times, was also sketched. Traces of the Hindu-Buddist movement are evident especially in the folk-lore; while the great effects of the introduction of Mohammedism and Christianty on the bulk of the population are a part of historic record.

The greater part of the evening was devoted to a description of the most fundamental facts of the religious, social, and economic life of three pagan tribes—the Bagobo of Southern Mindanao, the Bontoc Igorot, and the Tinguian of Northern Luzon.

The Bagobo live on the lower slopes of Mt. Apo, the highest mountain of the Philippines. Near the summit of this mountain is a deep fissure from which clouds of sulphur fumes and steam are continually rising, while frequent earthquakes give evidence of latent energy. In this peak a great host of spirits are supposed to dwell, but the most powerful are Mandarangan and Darago, a male and a female, who are the patrons of the warriors and in whose honor human sacrifices are held each year. Other spirits look after the workers in brass and in iron, and the weavers, and some dwell in the fields and protect the crops; while each family has its special protecting spirit. Offerings of food both cereal and of flesh and blood are made to all of these, as well as to the low mean spirits which seek to injure mortals; but to the greatest and most powerful of all the spirits only white offerings of rice and the like are presented. There is also a belief in a class of powerful spirits who inhabit the realms above the earth. These beings take no interest in the affairs of men, and no offerings or supplications are made to them. Each person is thought to have two spirits or souls—one on the right side and one on the left. The first of these finally goes to the land of the dead, while the second continues to roam the earth as a flesh devouring *buso*, or evil spirit.

The Bagobo are ruled over by *dato* or petty rulers, who in turn are subservient to the chief *dato*. Slavery and polygamy are both found in the tribe, but the slavery is of a mild type, and it is possible for the members of this class to become merged into the general population. Agriculture is of great importance, though conducted in a very primitive fashion, but rice terraces are quite unknown.

Going to Northern Luzon Dr. Cole showed the Igorot and Tinguian living under similar geographic conditions, their territories joining along the northwestern, border of Bontoc. The whole belt is exceedingly mountainous, the jungle being absent except in the deep valleys, and the rivers are small except during the rainy season when they become rushing torrents. Under these conditions it would be impossible to support a large population either by hunting or fishing, and the people have taken seriously to agriculture. The rugged nature of the land has caused them to terrace the mountain sides and in connection with these elevated fields, an elaborate system of irrigation has been worked out. Both tribes have, until recent years, been ardent head hunters, but the motives for taking the skull as well as the final disposition of the trophy varies in the two districts. In language

and physical type the people are much alike, but there most of the similarity ends.

A Bontoc village is divided into *ato* or political divisions each one of which is governed by an oligarchy of old men. The leaders of the various *ato* meet from time to time to decide matters of importance to the village. These *ato* are also exogamic divisions of the settlement and each has its man's house in which all unmarried men and boys must sleep. It also serves as a council house and as the storage place for drums and other ceremonial paraphernalia. Here also are kept the skulls of enemies. Unmarried girls sleep in the *olag* or girls' house from the age of about four years until their marriage. Trial marriage is common, a final union seldom taking place until the birth of a child is assured.

Going to the Tinguian a radically different type of house construction is encountered. The villages are not divided into political or exogamic groups; the man's house and the girls' dormitory are not found, nor is trial marriage practiced. The government of the village is in the hands of a head man known as *lakay*, who may if he desires call in other old men to aid him in the decision of important matters.

Dr. Cole ended his talk with a somewhat detailed description of the religious beliefs of the Tinguian; the possession of their mediums by the spirits; and the ceremonies conducted to bring health and prosperity to the group.

About one hundred colored lantern slides were used in illustration.

The 510th meeting of the Society was held at the Natural History Building of the National Museum, April 3, 1917. At this meeting Leo J. Frachtenberg, of the Bureau of American Ethnology, presented a paper on *The religious ideas of the Northwest Coast Indians.*

Dr. Frachtenberg stated that four important features of the religious ideas noted among the Indians of this region are: (1) An intensive animism; (2) a belief in the powers of supernatural beings as dwarfs and giants; (3) a belief in the existence of guardian spirits; (4) a complete absence of the social phase of religion.

According to Dr. Frachtenberg many religious ideas are common to all the tribes of the Northwest Coast, yet the northern and southern portions of this area are found to differ in cosmogony. The tribes in the extreme southern portion believe that the world was created out of a watery mist, the Transformer enlarging a small piece of land until it became large enough for habitation. The tribes of the northern portion are satisfied with a world whose origin is not explained. They hold, however, that the Transformer (Creator) first made man and the members of faunal and floral kingdoms, and at a later time returned and improved this creation. Two visits of the Transformer are typical of this region. In the south the Transformer (Creator) and the Trickster are separate individuals, while in the north they are unified. In the south the Transformer makes all that is good, and the Trickster is held responsible for all the bad elements; while in the

north there is no such dissociation. Good and evil things were alike created by the Transformer.

The Northwest Coast Indians believe that an individual comprises a body inhabited by two "souls" and a "ghost." In a slight illness the "outer soul" becomes separated from the body, in a serious illness the "inner soul" wanders to the "country of souls" but may be recalled by the shaman. When death occurs the "ghost" also departs and the shaman has no further power. The "country of souls" contains two division, one inhabited by recently arrived souls, the other by souls which have been there for a longer time. On their journey to this land the souls pass a "rest-house," then a "lake" and a "berry-ground." Their way is barred by a "spring-pole," and they must cross a "rotten log," the final barrier being a wide river.

No ritual or systematic form of supplication is found among these Indians, indeed it may be said that guardian spirits take the place of deities. Every man and woman possesses one or more guardian spirits each of which has its special sphere of influence. Thus there are guardian spirits for securing good weather and plenty of seal or whale, guardian spirits for success in hunting, and for help in making baskets and canoes. No offerings accompany a request to a guardian spirit. Crude representations of these spirits are seen on the implements and on the house-posts of their owners.

The shamans receive their power from a multitude of spirits. Certain shamans are considered to have power to cure sickness, while it is believed that others can "steal a man's soul," causing either serious illness or death. Large gifts are exacted by the shamans, who are both respected and feared.

In the discussion which followed the reading of the paper Dr. J. R. SWANTON called attention to the nascent dualism and monism in the religious beliefs of the Indians of the southern and northern areas considered by the speaker. Dr. I. M. CASANOWICZ noted the strange fact that many primitive religious ideas bear a resemblance to the most advanced religious ideas of the present time. Dr. J. W. FEWKES said that primitive Indians are so low in the cultural scale that they develop only the most general religious principles, these being modified by the several geographic areas inhabited by them. He stated further that there is no unity in the primitive religions of the American Indians, though some parallelisms are found between the beliefs held in different areas. Dr. TRUMAN MICHELSON mentioned some differences between the religious ideas of the Northwest Coast Indians and those of the Algonquian tribes, one of the chief differences being that the latter do not believe in a plurality of souls.

FRANCES DENSMORE, *Secretary.*

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